CLAIMS:

1. A method of simulating an industrial process comprising the steps of:

storing model data indicative of a plurality of processes involving a number of items of equipment to be used in an industrial process to be simulated;

determining scheduling data for initiating batches against which said processes are to be simulated; and

generating output data indicative of a simulation of an industrial process utilising said stored model data and said scheduling data,

characterised in that said determination of scheduling data comprises the steps of:

determining a minimum possible processing time for each item of equipment involved in simulated processing of an initiated batch in accordance with said model data;

determining for batches currently being processed the greatest time of use of items of equipment utilised in processing said batches; and

generating scheduling data for scheduling the initiation of the next batch after said initiated batch, said scheduling data being such to cause the time between an initiated batch and said next batch within said simulation to be equal to the greater of the maximum of

said minimum process times for said items of equipment and said greatest time of use for said items of equipment.

2. A method in accordance with claim 1, wherein said determination of the greatest time of use of an item of equipment utilised in processing comprises the steps of:

storing in association with each item of equipment to be simulated data indicative of the time of use of said item of equipment for a batch previously processed by said item of equipment; and

determining as the greatest time of use the greatest time of use of said stored times of use.

3. A method in accordance with claim 1, wherein said determining of the greatest time of use of an item of equipment further comprises for each of the said items of equipment the steps of:

determining whether an item of equipment is in use; and if an item of equipment is in use determining the total time the item of equipment has been in use for a current batch; and if an item of equipment is no longer in use storing said total time in use as said time in use for said equipment.

4. A method in accordance with claim 3, wherein each of said items of equipment is associated with a number of processes wherein said determination of whether an item of equipment is in use comprises determining whether any of said processes associated with said item of equipment is currently being simulated.

5. A method in accordance with claim 1, wherein said determining of a minimum possible processing time of an initiated batch comprises the step of storing in association with each batch to be initiated data indicative of the greatest of said minimum possible processing times; and said generation step comprises utilising said data to generate scheduling data.

6. A method in accordance with claim 1, wherein said determination of a minimum possible processing time comprises the steps of:

associating with a batch to be initiated data to be indicative of the items of equipment to be utilised in simulated processing of said batch; and

determining said minimum possible processing times for each item of equipment associated with said batch.

7. A method in accordance with claim 6, wherein each

of the said items of equipment is associated with a number of processes, each of said processes having associated therewith a completion condition, at the least some of said completion conditions comprising the lapse of specified time period in the simulation of a process, wherein said determination of a minimum possible processing time for an item of equipment comprises determining the sum of said specified time periods for said processes of said items of equipment.

8. A method in accordance with claim 7, wherein said storage step further comprises associating with at least some of said plurality of processes involving said items of equipment, rate data and said generation of output data comprises for each step in a simulation the steps of:

determining whether any process of said plurality of processes to be simulated is associated with rate data;

determining the minimum time increment required to complete any of the processes currently being simulated; and

selecting as a step size for generating output data a default step size, if at least one process associated with rate data is to be simulated and said default step

size is smaller than said determined minimum time increment, and selecting as said step size said determined minimum time increment if no process to be simulated is associated with rate data or said default step size is greater than said determined minimum time increment.

9. A method of simulating an industrial process comprising the steps of:

storing model data indicative of a plurality of processes involving a number of items of equipment to be used in an industrial process to be simulated;

determining a time increment to be used with said model data; and

generating output data indicative of a step within a simulation of an industrial process utilising said stored model data and said determined step size, characterised in that said storage step comprises the step of storing rate data in relation to at least some of said processes, and

that said determination step comprises for each step in a simulation; the steps of:

determining whether any process of said plurality of processes to be simulated is associated with rate data;

determining the minimum time increment required to complete any of the processes currently being simulated; and

selecting as a step size for generating output data a default step size, if at least one process associated with rate data is to be simulated and said default step size is smaller than said determined minimum time increment, and selecting as said step size said determined minimum time increment if no process to be simulated is associated with rate data or said default step size is greater than said determined minimum time increment.

10. A method in accordance with claim 8, wherein said storage step further comprises associating with said at least some of said plurality of processes, utility type data, and said generation of output data comprises for steps in a simulation generating output data associated with items of utility type data utilizing rate data associated with a process being simulated and said determined step size.

11. A method in accordance with claim 10, wherein said generation of output data comprises for steps in a simulation determination of output data representative

of instantaneous demand for a utility corresponding to an item of utility type data utilizing determined sums of rate data associated with said utility type data for processes being simulated.

12. A method in accordance with claim 10, wherein said generation of output data for steps within a simulation comprises storing in association with items of utility data, quantity data indicative of a current quantity of a utility within a simulation wherein said quantity data is determined utilizing rate data associated with processes being simulated and said determined step size.

13. A method in accordance with claim 12, wherein said quantity data for a step in a simulation is determined by incrementing or decrementing quantity data associated with utility type data for the previous step in a simulation by the product of said determined step size and the sum of rate data associated with said utility data and processes being simulated.

14. A method in accordance with claim 13, wherein said storage step further comprises storing in association with said items of utility type data, minimum quantity data and generation rate data, wherein the determination

of quantity data associated with an item of utility type data for a step within a simulation comprises the step of incrementing or decrementing quantity data for the previous step in a simulation by the product of said generation rate data and said determined step size if said quantity data is less than said minimum quantity data associated with said utility type.

15. A method in accordance with claim 14, wherein said storage step further comprises storing in association with said items of utility type data, maximum quantity data wherein the determination of quantity data associated with an item of utility type data for a step within a simulation comprises the step of incrementing or decrementing quantity data for the previous step in a simulation by the product of said generation rate data and said determined step size only when said quantity data associated with said utility type does not exceed said maximum quantity data associated with said utility type.

16. A method in accordance with claim 10, wherein said generated output data associated with utility type data comprises data indicative of the simulated availability of utilities or waste processing capacity.

17. A method in accordance with claim 12, wherein said storage step comprises storing in association with at least some of said plurality of processes, data indicative of a continuation condition, and said generation of output data comprises for each step in a simulation, the steps of:

determining which of said plurality of processes are to be simulated in said step of said simulation;

determining for processes to be simulated associated with data indicative of a continuation condition whether output data generated for the previous step in said simulation fulfils the continuation condition defined by said data; and

if a continuation condition for a process being simulated is not fulfilled simulating a delay in the continued processing of said process.

18. A method of simulating an industrial process comprising the steps of:

storing model data indicative of a plurality of processes involving a number of items of equipment to be used in an industrial process to be simulated; and

generating output data indicative of a simulation of an industrial process utilizing said stored model data, characterised in that said storage step comprises

storing in association with at least some of said plurality of processes, data indicative of a continuation condition, and said generation of output data comprises for each step in a simulation, the steps of:

determining which of said plurality of processes are to be simulated in said step of said simulation;

determining for the processes to be simulated associated with data indicative of a continuation condition whether output data generated for the previous step in said simulation fulfils the continuation condition defined by said data; and

if a continuation condition for a process being simulated is not fulfilled simulating a delay in the continued processing of said process.

19. A method in accordance with claim 17, wherein said data indicative of a continuation condition comprises data defining an equation which quantity data associated with utility type data is to fulfill.

20. A method in accordance with claim 17, wherein said storage step comprises storing data in association with each of said plurality of processes indicative of the next processes to be simulated following the completion of each said process wherein said determination of which

of said plurality of processes are to be simulated comprises the steps of:

determining for each process simulated in the previous step of a simulation whether the completion condition associated with each said process has been fulfilled; and

determining as processes to be simulated processes for which said completion conditions have not been fulfilled and said next processes associated with processes for which said completion conditions have been fulfilled.

21. A method of performing an industrial process comprising the steps of:

simulating an industrial process in accordance with any preceding claim to determine apparatus required to perform a process;

providing apparatus corresponding to said items of equipment simulated; and

utilizing said apparatus to perform said industrial process simulated.

22. An apparatus for generating a simulation of an industrial process comprising:

storage means for storing model data indicative of

a plurality of processes involving a number of items of equipment to be used in an industrial process to be simulated;

determination means for determining scheduling data for initiating batches against which said processes are to be simulated; and

generation means for generating output data indicative of a simulation of an industrial process utilising stored model data and determined scheduling data,

characterised in that said determination means comprises:

means for determining a minimum possible processing time for each item of equipment involved in simulated processing of an initiated batch in accordance with stored model data;

means for determining for batches currently being processed the greatest time of use of items of equipment utilised in processing said batches; and

means for generating scheduling data for scheduling the initiation of the next batch after an initiated batch, said scheduling data being such to cause the time between an initiated batch and said next batch within a simulation to be equal to the greater of the maximum of said determined minimum process times for said items of

equipment and said determined greatest time of use for said items of equipment.

23. An apparatus in accordance with claim 22, wherein said means for determining the greatest time of use of an item of equipment comprises:

means for storing in association with each item of equipment to be simulated data indicative of the time of use of said item of equipment for a batch previously processed by said item of equipment, said means for determining the greatest time of use being arranged to determine as the greatest time of use the greatest time of use of said stored times of use stored in said means for storing.

24. An apparatus in accordance with claim 22, wherein said means for determining of the greatest time of use of an item of equipment is arranged to determine for each of the said items of equipment whether an item of equipment is in use; and if an item of equipment is in use to determine the total time the item of equipment has been in use for a current batch; and if an item of equipment is no longer in use to store said total time in use as said time in use for said equipment.

25. An apparatus in accordance with claim 24, wherein said storage means is arranged to store model data associating each of said items of equipment with a number of processes wherein said means for determining the greatest time of use of an item of equipment being arranged to determine whether any of said processes associated with an item of equipment is currently being simulated to determine whether an item of equipment is in use.

26. An apparatus in accordance with claim 22, wherein said means for determining a minimum possible processing time comprises means for storing in association with each batch to be initiated data indicative of the greatest of said minimum possible processing times, said determination means being arranged to utilize said data to generate scheduling data.

27. An apparatus in accordance with claim 22, wherein said means for determining a minimum possible processing time comprises: means for associating with a batch to be initiated data indicative of the items of equipment to be utilised in simulated processing of said batch, said means for determining a minimum possible processing times being arranged to utilize said data associated with said

batch.

28. An apparatus in accordance with claim 27, wherein said storage means is arranged to associate said items of equipment with data indicative of a number of processes each of said processes having associated therewith a completion condition, at the least some of said completion conditions comprising the lapse of specified time period in the simulation of a process, wherein said means for determining a minimum possible processing time for an item of equipment is arranged to determine the sum of said specified time periods for said processes of said items of equipment.

29. An apparatus in accordance with claim 28, wherein said storage means is further arranged to associate with at least some of said plurality of processes, rate data and wherein said generation means further comprises:

means for determining whether any process of said plurality of processes to be simulated is associated with rate data;

means for determining the minimum time increment required to complete any of the processes currently being simulated; and

selection means for selecting as a step size for

generating output data a default step size, if at least one process associated with rate data is to be simulated and said default step size is smaller than said determined minimum time increment, and selecting as said step size said determined minimum time increment if no process to be simulated is associated with rate data or said default step size is greater than said determined minimum time increment.

30. An apparatus for generating a simulation of an industrial process comprising:

storage means for storing model data indicative of a plurality of processes involving a number of items of equipment to be used in an industrial process to be simulated;

means for determining a time increment to be used with said model data; and

generation means for generating output data indicative of a step within a simulation of an industrial process utilising said stored model data and a determined step size, characterised in that said storage means is arranged to store rate data in relation to at least some of said processes, and

that said means for determining a time increment comprises:

means for determining whether any process of said plurality of processes to be simulated is associated with rate data;

means for determining the minimum time increment required to complete any of the processes currently being simulated; and

selection means for selecting as a step size for generating output data a default step size, if at least one process associated with rate data is to be simulated and said default step size is smaller than said determined minimum time increment, and selecting as said step size said determined minimum time increment if no process to be simulated is associated with rate data or said default step size is greater than said determined minimum time increment.

31. An apparatus in accordance with claim 29, wherein said storage means is further arranged to associate with said at least some of said plurality of processes, utility type data, and said generation means is arranged to output data associated with items of utility type data utilizing rate data associated with a process being simulated and said determined step size.

32. An apparatus in accordance with claim 31, wherein

said generation means is arranged to output data representative of instantaneous demand for a utility corresponding to an item of utility type data utilizing determined sums of rate data associated with said utility type data for processes being simulated.

33. An apparatus in accordance with claim 31, wherein said storage means is arranged to store in association with items of utility data, quantity data indicative of a current quantity of a utility within a simulation, and wherein said generation means is arranged to output quantity data is determined utilizing rate data associated with processes being simulated and said determined step size.

34. An apparatus in accordance with claim 31, wherein said generation means is arranged to determine quantity data for a step in a simulation by incrementing or decrementing quantity data associated with utility type data for the previous step in a simulation by the product of said determined step size and the sum of rate data associated with said utility data and processes being simulated.

35. An apparatus in accordance with claim 34, wherein

said storage means is further arranged to store in association with said items of utility type data, minimum quantity data and generation rate data, wherein said generation means is arranged to output quantity data associated with an item of utility type data for a step within a simulation by incrementing or decrementing quantity data for the previous step in a simulation by the product of said generation rate data and said determined step size if said quantity data is less than said minimum quantity data associated with said utility type.

36. An apparatus in accordance with claim 35, wherein said storage means is further arranged to store in association with said items of utility type data, maximum quantity data wherein said generation means is arranged to output quantity data associated with an item of utility type data for a step within a simulation determined by incrementing or decrementing quantity data associated with said utility type for the previous step in a simulation by the product of said generation rate data and said determining step size only when said quantity data associated with said utility type does not exceed said maximum quantity data associated with said utility type.

37. An apparatus in accordance with claim 31, wherein said storage means is arranged to store in association with at least some of said plurality of processes, data indicative of a continuation condition, and said generation means comprises:

means for determining which of said plurality of processes are to be simulated in said step of said simulation; and

means for determining for processes to be simulated associated with data indicative of a continuation condition whether output data generated for the previous step in said simulation fulfils the continuation condition defined by said data; and if a continuation condition for a process being simulated is not fulfilled simulating a delay in the continued processing of said process.

38. An apparatus for simulating an industrial process comprising:

storage means for storing model data indicative of a plurality of processes involving a number of items of equipment to be used in an industrial process to be simulated; and

generation means for generating output data indicative of a simulation of an industrial process

utilizing said stored model data, characterised in that said storage means is arranged to store in association with at least some of said plurality of processes, data indicative of a continuation condition, and said generation means comprises:

means for determining which of said plurality of processes are to be simulated in said step of said simulation;

means for determining for the processes to be simulated associated with data indicative of a continuation condition whether output data generated for the previous step in said simulation fulfils the continuation condition defined by said data; and if a continuation condition for a process being simulated is not fulfilled simulating a delay in the continued processing of said process.

39. An apparatus in accordance with claim 37, wherein said storage means is arranged to store data indicative of a continuation condition comprises data defining an equation which quantity data associated with utility type data is to fulfill.

40. An apparatus in accordance with claim 37, wherein said storage means is adapted to store data in

association with each of said plurality of processes indicative of the next processes to be simulated following the completion of each said process wherein said means for determining of which of said plurality of processes are to be simulated comprises the steps of:

means for determining for each process simulated in the previous step of a simulation whether the completion condition associated with each said process has been fulfilled; and

means for determining as processes to be simulated processes for which said completion conditions have not been fulfilled and said next processes associated with processes for which said completion conditions have been fulfilled.

41. A method in accordance with claim 1, wherein said determination of scheduling data further comprises the steps of:

when a batch is being initiated determining time remaining in a current shift and re-scheduling said batch if said time remaining is less than an estimated time required for processing said batch.

42. A method in accordance with claim 41, wherein aid re-scheduling of said batch comprises re-scheduling said

batch for the next shift if said time remaining is less than a minimum processing time for said batch.

43. A method in accordance with claim 41, wherein said estimated time required is determined by calculating the sum of the greater of the greatest time of use of items of equipment utilized in processing said batches and minimum possible processing times for processing said batch in accordance with said model data for said items of equipment.

44. An apparatus in accordance with claim 22, wherein said determination means for determining scheduling data is operable when a batch is being initiated to determine time remaining in a current shift and re-schedule said batch if said time remaining is less than an estimated time required for processing said batch.

45. An apparatus in accordance with claim 44, wherein said re-scheduling of said batch comprises re-scheduling said batch for the next shift if said time remaining is less than a minimum processing time for said batch.

46. An apparatus in accordance with claim 44, wherein said estimated time is determined by calculating the sum

of the greater of the greatest time of use of items of equipment utilized in processing said batches and minimum possible processing times for processing said batch in accordance with said model data for said items of equipment.

47. A recording medium, storing computer implementable processor steps for performing a method in accordance with any of claims 1 to 20 or 42 to 43.

48. A recording medium storing computer implementable processor step for generating within a programmable computer an apparatus in accordance with any of claims 22 to 40 or 44 to 46.

49. A recording medium in accordance with claim 47 comprising a computer disc.

50. A recording medium in accordance with claim 47, comprising an electric signal transferred via the Internet.

51. A computer disc in accordance with claim 49, wherein said computer disc comprises an optical, magneto-optical or magnetic disc.